
Space Weather Technical Forecast

Issued on Sunday 29 September 2024 at 01:26 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales <https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales>

Space Weather Forecast Headline: Chance of M-flares (R1-R2 Blackouts).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Low with a peak C3.7 flare observed at 28/0611 UTC from AR3835. There are ten sunspot regions visible, with the most complex of these being AR3842 in an area of plage near the southeast limb. This has a small delta spot to the south of its main negative leader, however the region remains relatively small and ragged looking. AR3835 and also AR3834 have also shown some growth, and are both located in the southwest quadrant, but remain relatively simple bipolar spots. AR3836, just east of the south-centre disc, is an unusual region, consisting of a large number of spots of one polarity, but very few opposite polarity ones. However this also remains relatively inactive. Some weak growth was also observed elsewhere on the disc, including AR3841 in the northeast, and the emergence of two very small new spots.

There were no Earth-directed CMEs.

Solar Wind / Geomagnetic Activity: A very weak influence from a glancing CME was observed, alongside the background slow wind. Solar wind speeds were initially around 300km/s, but rose to vary 300-350km/s after 28/0710 UTC. due to the CME glance. Density was mainly below average but rose to average with with CME. Interplanetary Magnetic Field, Bt, was initially weak at 4-6nT, but rose to be briefly Moderate with the CME at 7-10nT until 28/1130UTC, then became weak at 4-nT thereafter. The north-south component was initially positive (northward) at 4nT, but gradually rotated to become negative (southward) with minimum -8nT by 29/0839 UTC. The north-south component then became more turbulent, varying between +6 and -7nT. Phi angle was predominately positive (away from the Sun). Geomagnetic activity was Quiet to Unsettled (Kp 0-3).

Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux observed by GOES18 was at background levels. High energy electron flux (greater than 2MeV) observed by GOES16 was at background levels for much of the period, but with a period of Moderate 28/0835-2025 UTC, peaking 468 pfu at 28/1605 UTC. The associated 24-hour fluence was below the Active threshold. The 29/0000 UTC observation was 9.26e6 integrated pfu.

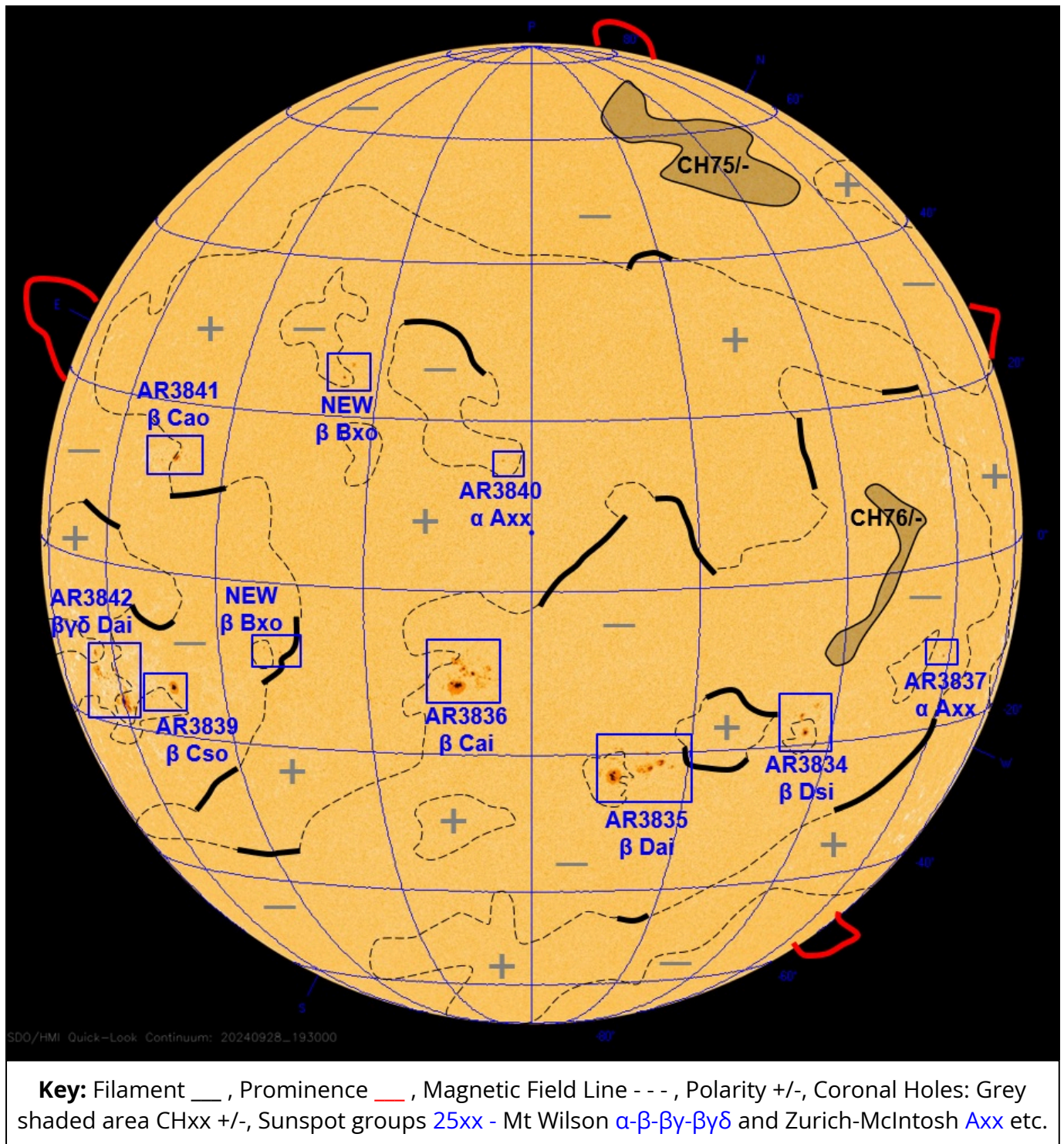
Four-Day Space Weather Forecast Summary

Solar Activity: Low to Moderate activity is expected, with a chance of further isolated M-class flares. There is a very slight chance of an isolated X-class flare from AR3842.

Solar Wind / Geomagnetic Activity: There are no Earth directed CMEs. Background solar winds are expected until a possible weak enhancement occurs, from the fast wind of CH76/-, with wind speeds perhaps reaching around 450km/s, most likely day 1-2 (29-30 Sep), before easing back to background slow wind conditions. Mainly Quiet (Kp 0-2) geomagnetic conditions are expected, but with a spell of Unsettled to Active (Kp 3-4) possible from any fast wind onset day 1-2 (29-30 Sep).

Energetic Particles / Solar Radiation: High energy proton flux at GOES18 is forecast to persist at background, High energy electron flux at GOES16 is currently ranging between Background and Moderate. A drop out in values is possible with the onset of any fast wind enhancement day 1-2 (29-30 Sep), before a possible recovery to Background to Moderate later in the period. The associated 24 hour fluence is expected to remain below the Active threshold (1e8 total pfu).

Figure 1: Solar Synoptic Map 28/2000 UTC



Geomagnetic Storms

There are no Earth-directed CMEs. However there are a number of filaments currently on the Earth-facing disc, which brings a slightly increased chance of CMEs being produced over the coming days.

Solar winds are currently at background, with the next potential enhancement from the onset of any fast wind from CH76/-, most likely to occur day 1-2 (29-30 Sep). However, confidence is low for the timing and strength of any onset due to this feature being an unfavourable polarity for a strong connection at this time of year, and also due its narrow appearance. MOSWOC Enlil is also providing little useful guidance due to it instead modelling a swathe of fast winds that has not been observed and has no clear source. A very weak, and relatively brief connection is most likely, with solar winds rising to around 450km/s for a time, before easing.

Overall, mainly Quiet Geomagnetic activity is expected with a chance of isolated Unsettled intervals. However any fast wind enhancement will bring the likelihood of an Unsettled to Active spell, most likely day 1 or day 2 (29-30 Sep). Confidence becomes lower by day four (02 Oct) due to the number of filaments currently on the disc, as any disruption could result in an Earth-directed CME, and a subsequent increase in geomagnetic activity towards the end of the period.

Geomagnetic Storm	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Minor or Moderate	G1 to G2	No	5	5	1	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Figure 2: SDO aia-211 (last rotation left and current rotation right). Narrow CH72 in the far west was evident last rotation and gave an enhancement to around 450 km/s. Similar possible on this occasion.

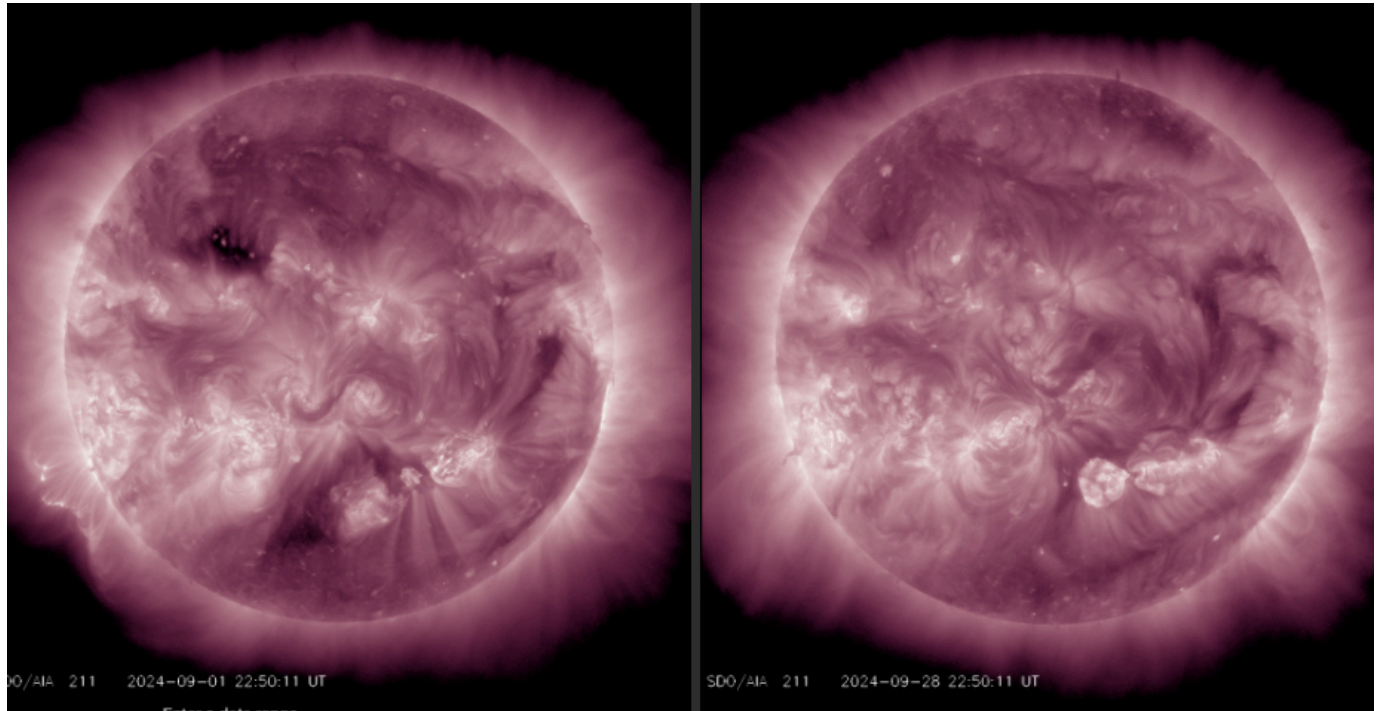
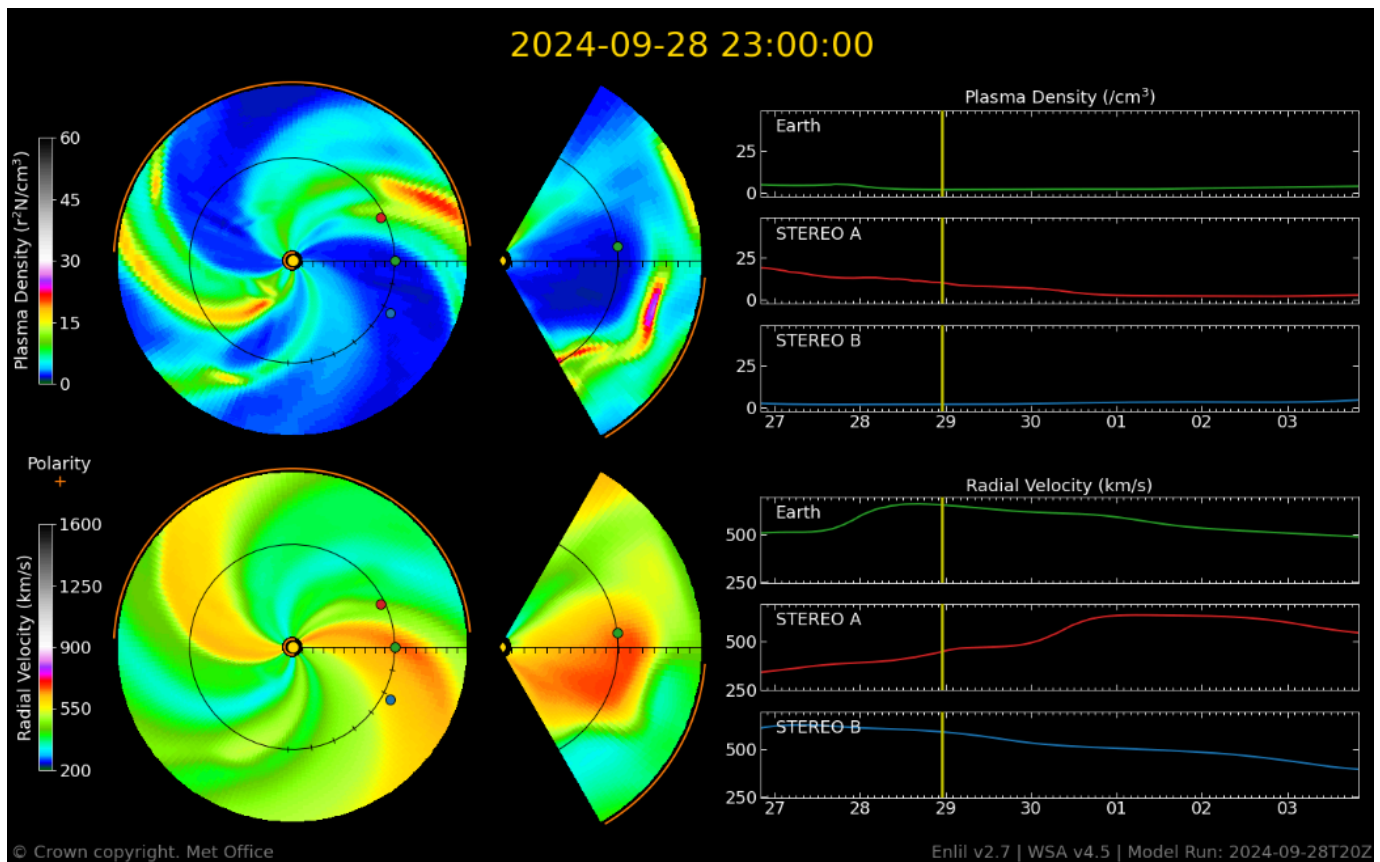


Figure 3: MOSWOC Enlil, showing an anomalous strong HSS which has not been observed.



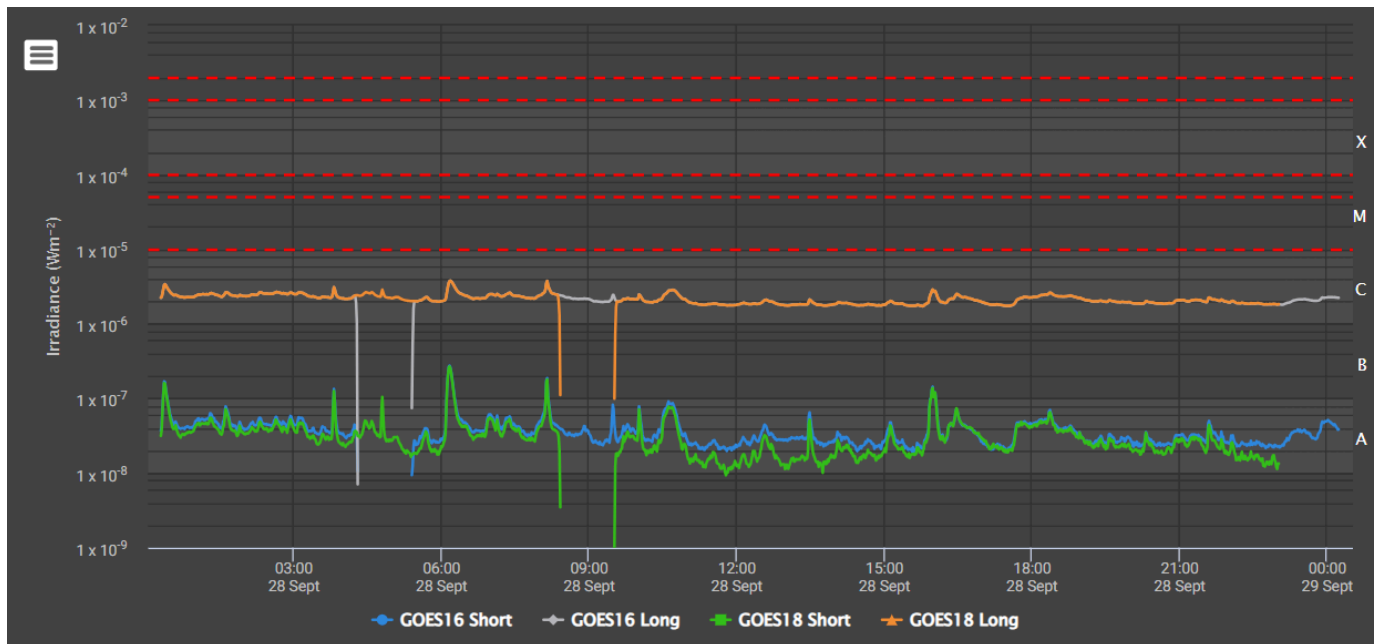
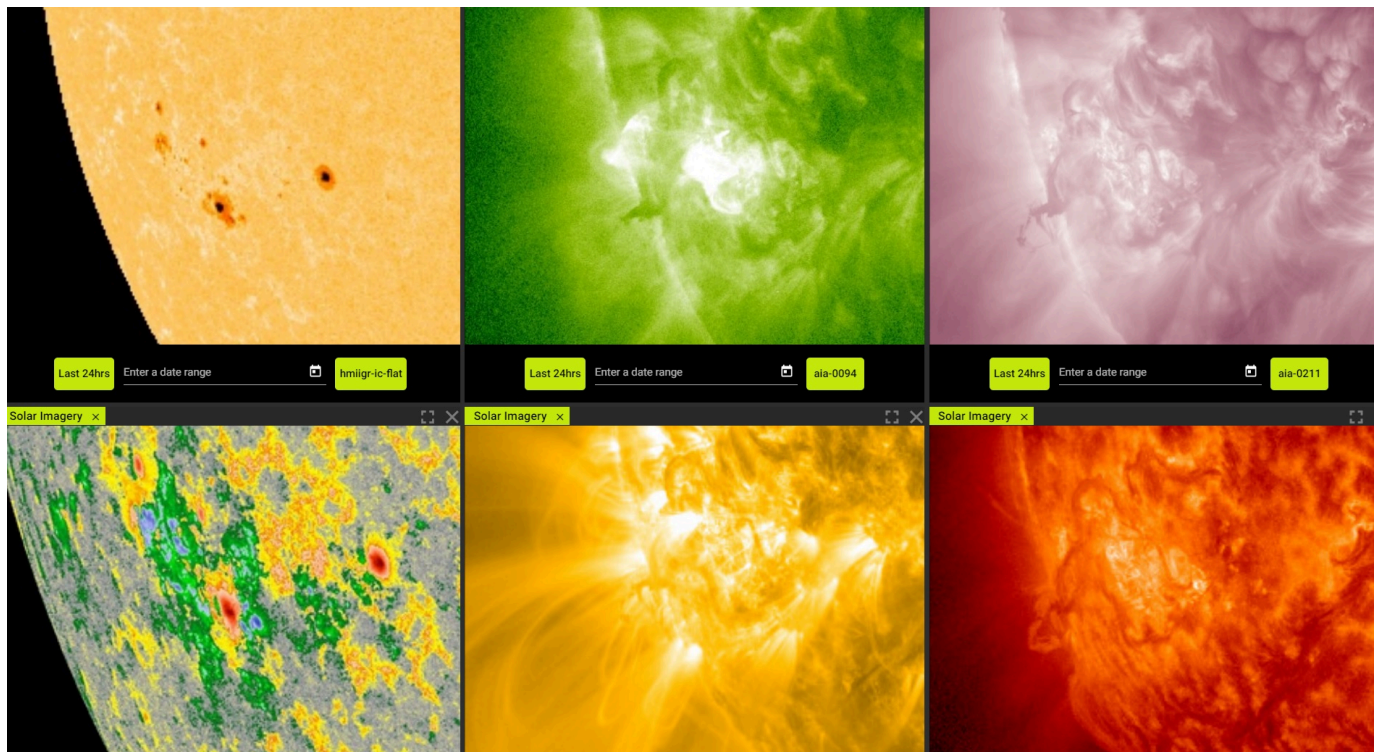
Radio Blackouts - X-Ray Flares

Low to Moderate activity is forecast with an ongoing chance of isolated M-class flares. There is a slight chance of X-class flares

There are ten visible sunspot regions. The most notable is AR3842 on the southeast disc, which is now moving into a less oblique viewing angle. This is a relatively small and ragged looking region, but set amongst a broad area of plage with a small delta spot on the the southern edge of its negative leader, and also appears bright on SDO aia-94 imagery. Further details are also likely to be apparent as it moves into a clearer view, along with some ongoing growth possible. This region is the most likely source of any larger or more significant flares.

Thee other regions are generally simpler, but include a few of note. AR3836 in the south-centre is an unusual region, consisting of a number of spots, but nearly all of a single negative polarity besides a small developing positive spot on its northern periphery. Growth has also been apparent in AR3835 and AR3834, both on the southwest disc, however these remain relatively simple bipolar regions and are showing signs of maturing with some of their smaller spots coalescing into larger ones. Some slight development has also been observed in AR3841 with some small peripheral spot emergence.

X-Ray Flares	Level	Past 24 Hours	Day 1	Day 2	Day 3	Day 4
Probability		(Yes/No)	(00-24 UTC)	(00-24 UTC)	(00-24 UTC)	(00-24 UTC)
			(%)	(%)	(%)	(%)
Active	R1-R2 (M Class)	No	50	50	50	50
Very Active	R3-R5 (X Class)	No	10	10	10	10

Figure 4: GOES 16/18 X-ray Irradiance**Figure 5: SDO imagery of AR3842 showing bright flux, some complex magnetic looping and small delta spot to the south of the main spot.**

Solar Radiation Storms (High Energy Protons)

High energy proton flux at GOES18 is forecast to persist at background levels. The current visible sunspots are generally small and simple providing only modest contributions to flare risk, and are unlikely to significantly impact proton flux at Earth. However, given the number of notable filaments currently on the disc, there is also a very low, albeit non-zero chance of observable protons should any significant filament eruption occur during the period.

Radiation Storms	Level (cm ⁻² sr ⁻¹ s ⁻¹)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ S1	No	5	5	5	5
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and/or 50 MeV ≥ 10pfu. (pfu = cm ⁻² sr ⁻¹ s ⁻¹)						

High Energy Electrons ($\geq 2\text{MeV}$)

High energy electron flux observed by GOES16 became Moderate for a time on 28 Sep, likely as a consequence of the previous fast wind enhancement on 25 Sep, and easing solar winds. Background to Moderate levels are expected to persist at first, although a more definitive drop out is likely later day 1 or day 2 (29-30 Sep) due to any fast wind that occurs from CH76/-. This is likely to be a relatively brief and weak enhancement, with electrons perhaps recovering to give periods of Moderate day 3-4 (01-02 Oct)

The associated 24 hour fluence is forecast to stay below Active ($1\text{e}8$ total pfu), in agreement with MOSWOC REFM, although this is currently underestimating observed values.

GEO Electron Environment	Level ($\text{cm}^{-2}\text{sr}^{-1}\text{day}^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	$\geq 2\text{ MeV}$ $\geq 1\times10^8$	No	1	1	1	1
Very Active	$\geq 2\text{ MeV}$ $\geq 1\times10^9$	No	1	1	1	1

Figure 6: GOES-16 >2MeV Electron flux and associated fluence with REFM

